

A stylized illustration of a space scene. In the foreground, a rocket with an orange body and white boosters is angled upwards. A large, grey, cratered moon is in the upper left. A thin, dark purple line representing a trajectory or orbit curves from the rocket towards the moon. The background is a dark blue space filled with small white stars and a few larger, multi-pointed starburst graphics in yellow, blue, and red.

DEVELOPMENT OF A CREW HEALTH AND PERFORMANCE SYSTEM PROBABILISTIC RISK ASSESSMENT TOOL: PROOF- OF-CONCEPT APPROACH

2023 NASA HRP Investigators Workshop

Jerry Myers¹

Suleyman Gokoglu¹

Raj Prabhu²

Courtney Schkurko¹

Beth Lewandowski¹

Mona Matar¹

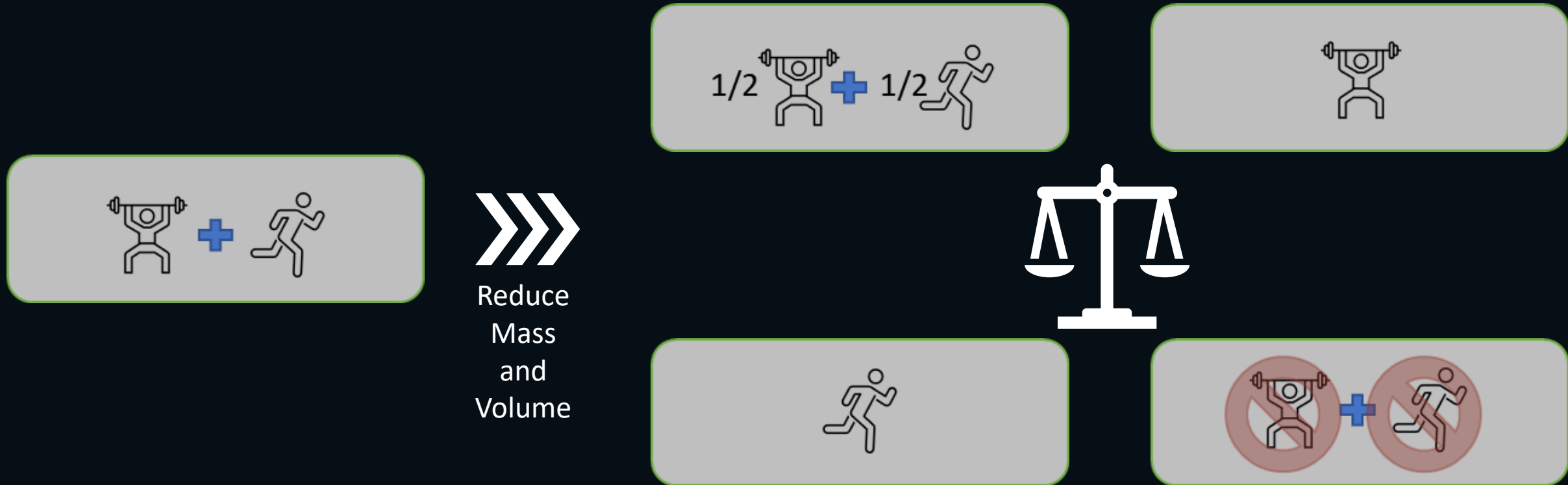
Drayton Munster¹

¹NASA GRC

Ian Milray¹

²NASA JSC

Consider this CHP-PRA Scenario



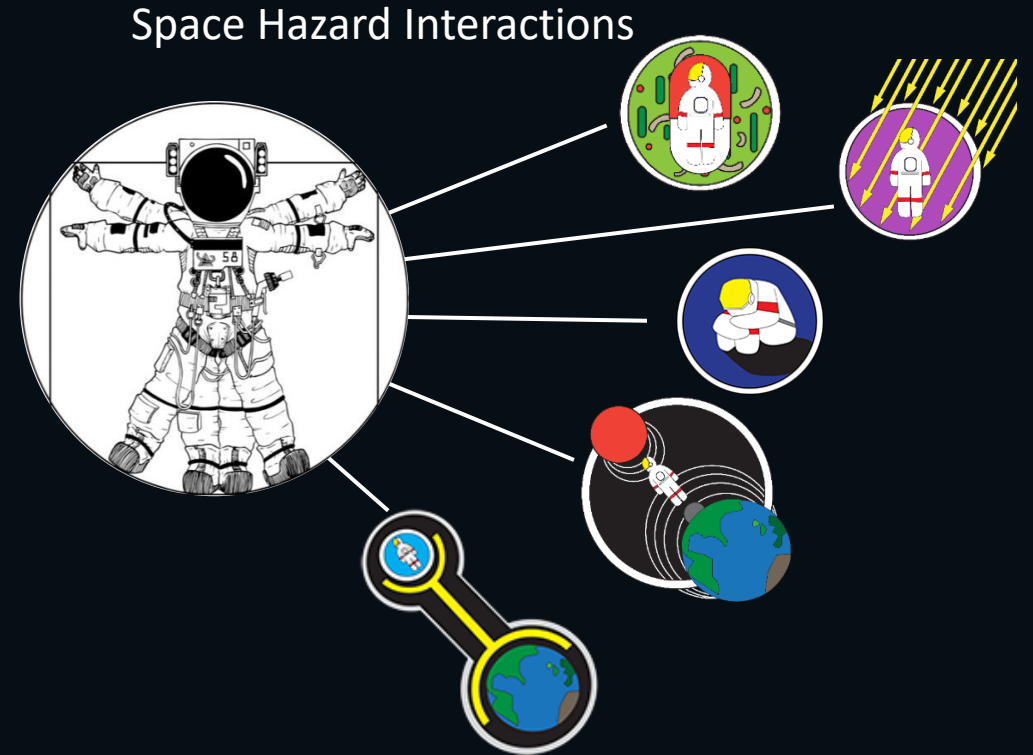
Many Factors to Weigh

30+ Human
Spaceflight
Risks

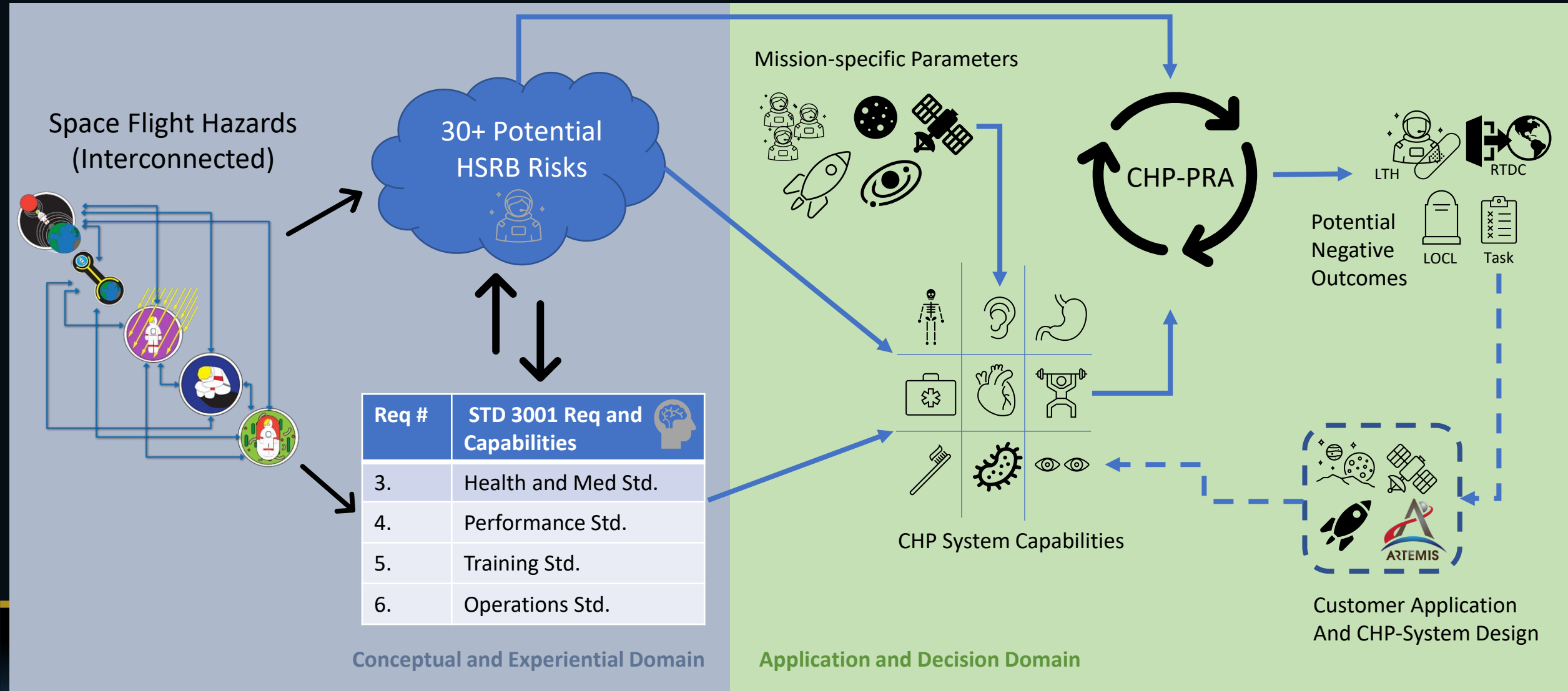
Vehicle
Constraints
and Mission
Objectives

Health and
Performance
Standards

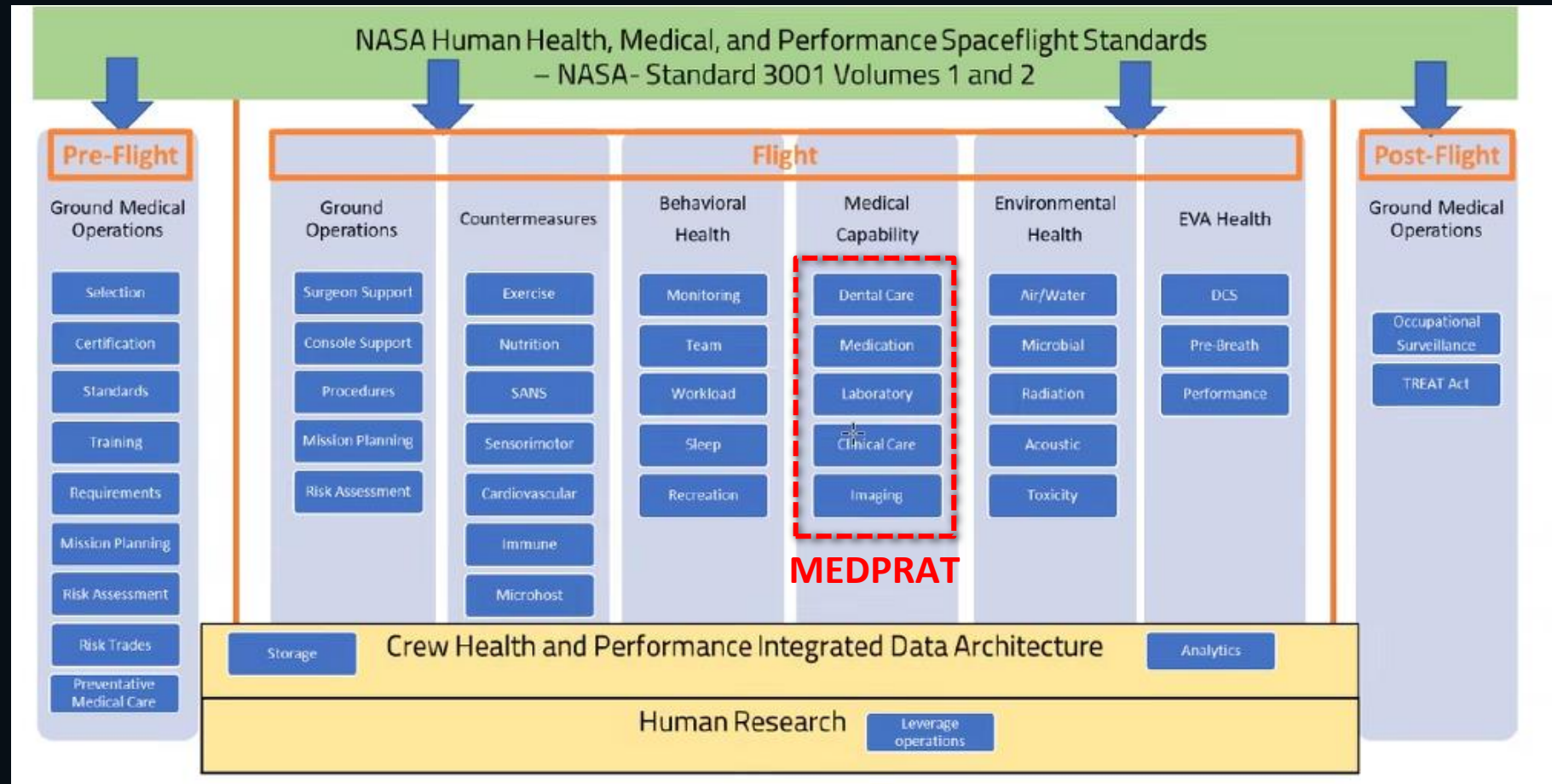
Crew Training
and Skill Mix



Could Influence the Design Path

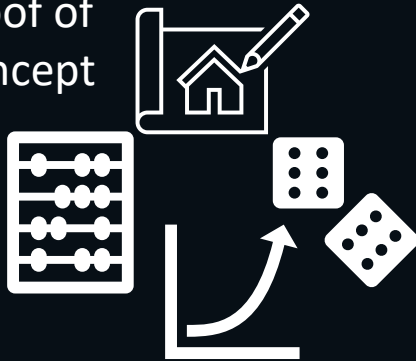


Crew Health & Performance System: HRP Mental Model

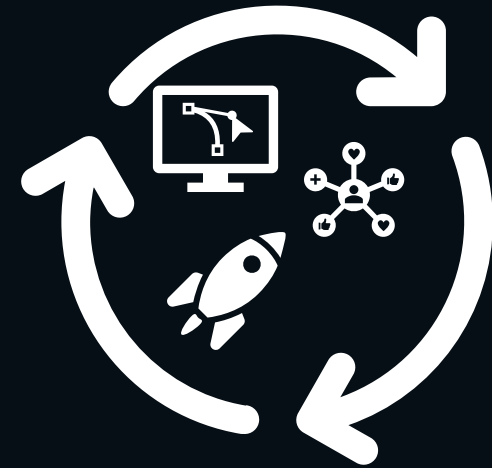


Reaching Our Goal

Proof of
Concept



We Are
Here



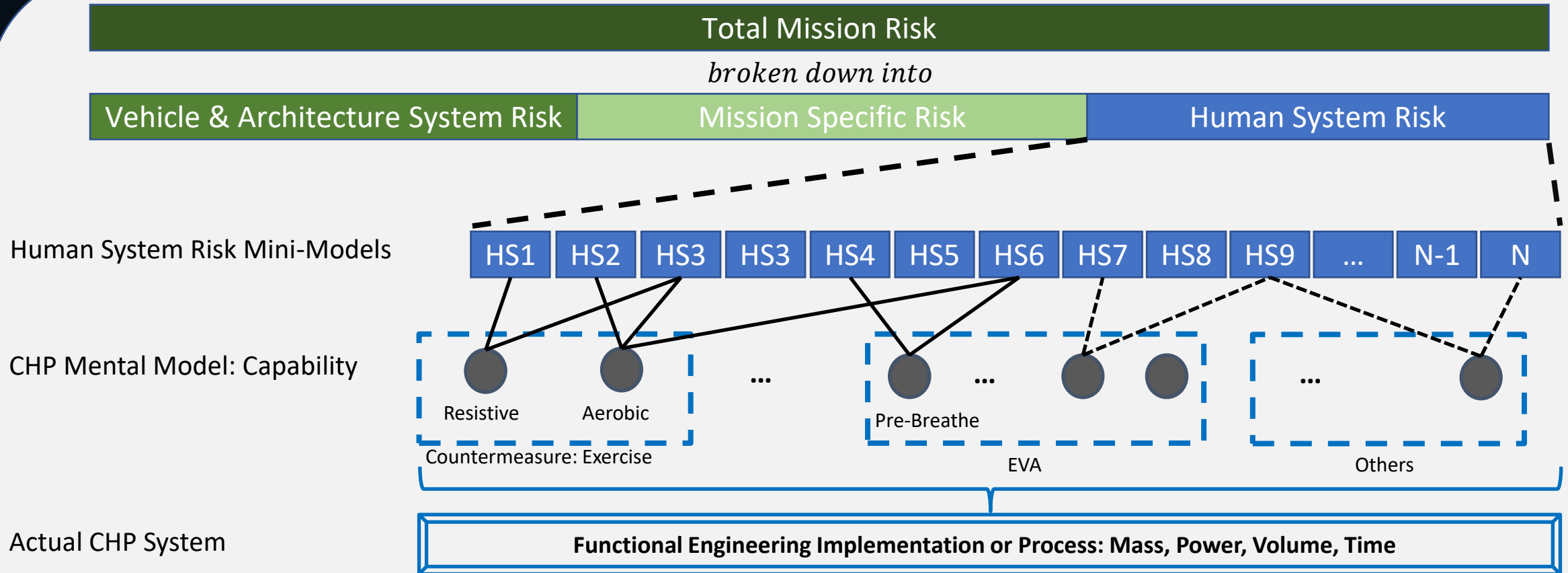
Comprehensive
PRA

Developing a Crew Health and Performance PRA Capability

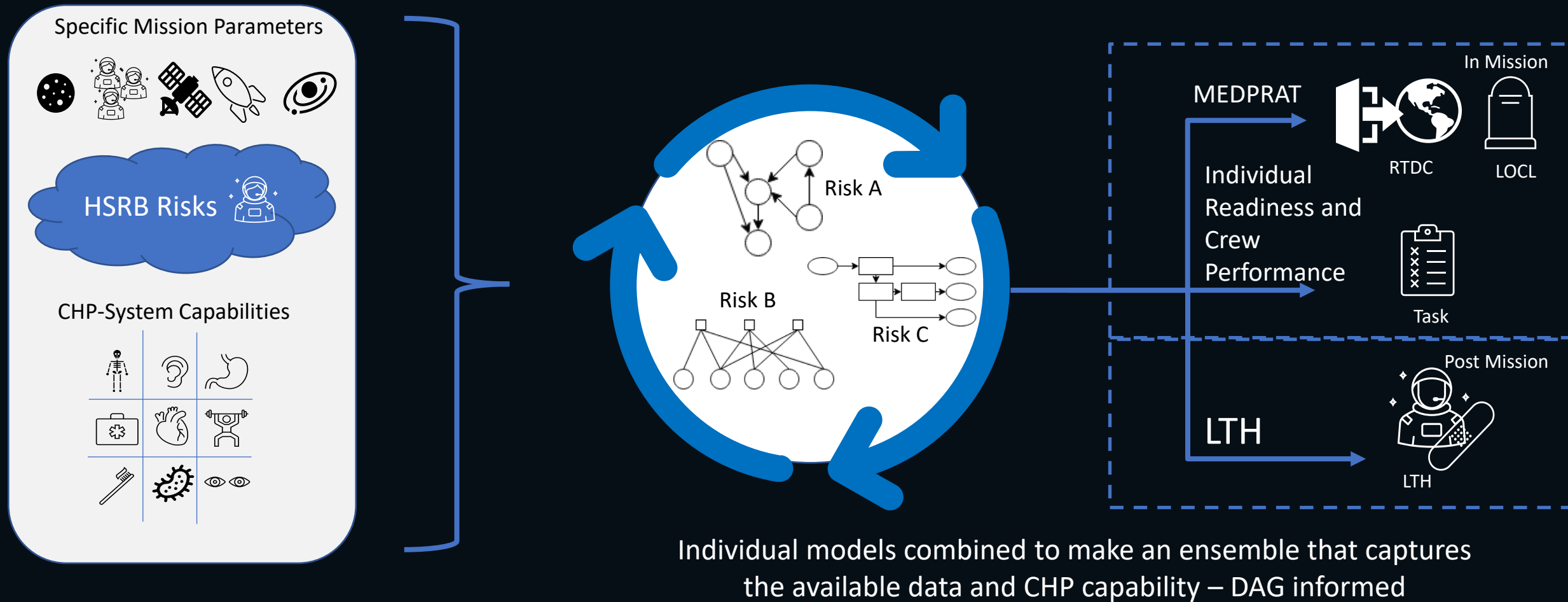
- “Comprehensive Model”
- “Series of Knobs”
- “Leverage HSRB DAGs”
- “Keep it Simple”
- Order of Magnitude Good Enough



Modest Cumulative Risk Approach

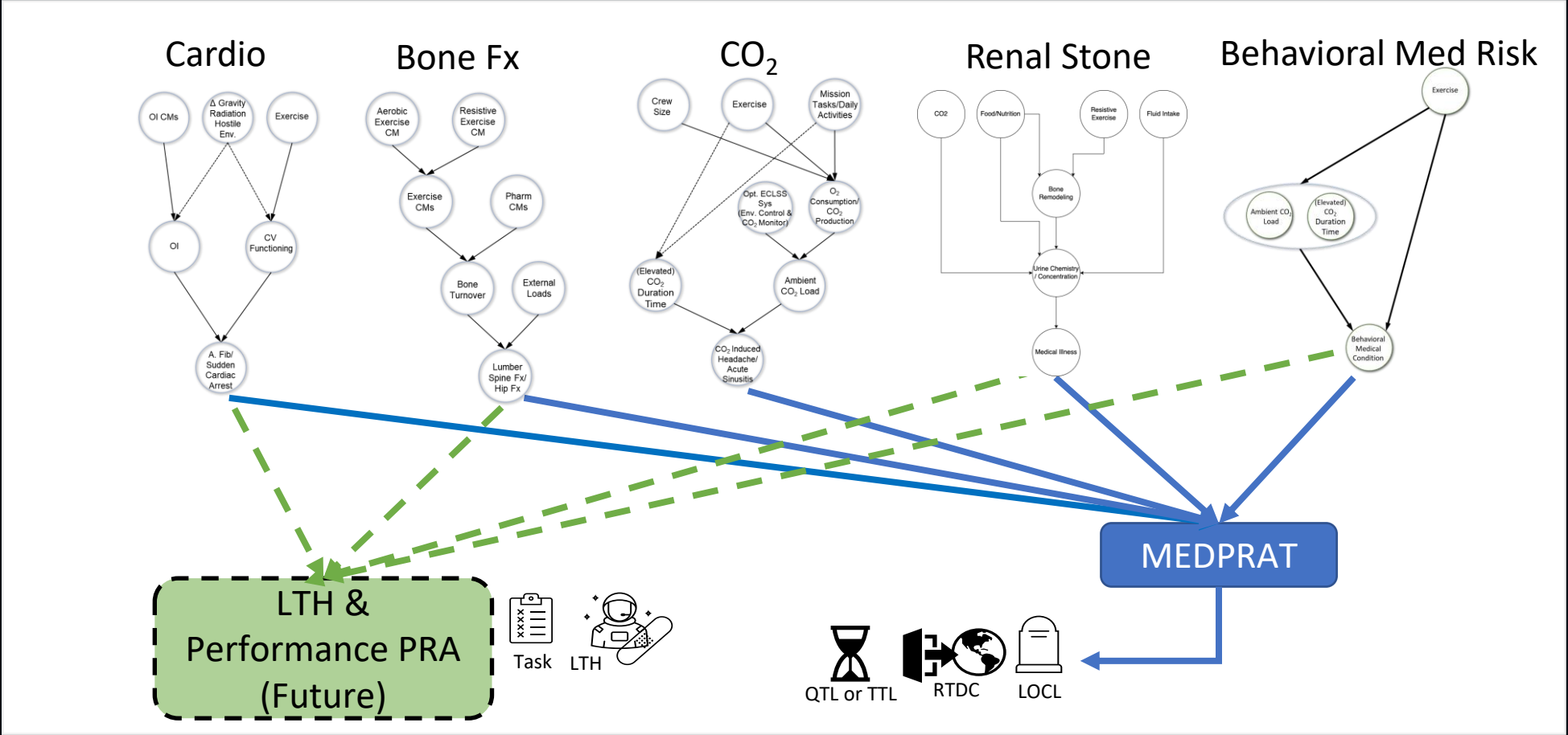
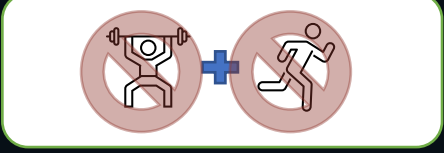
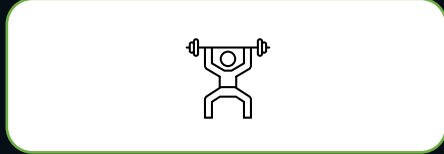
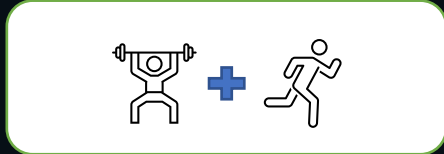


Strategy for an Early CHP-PRA Concept

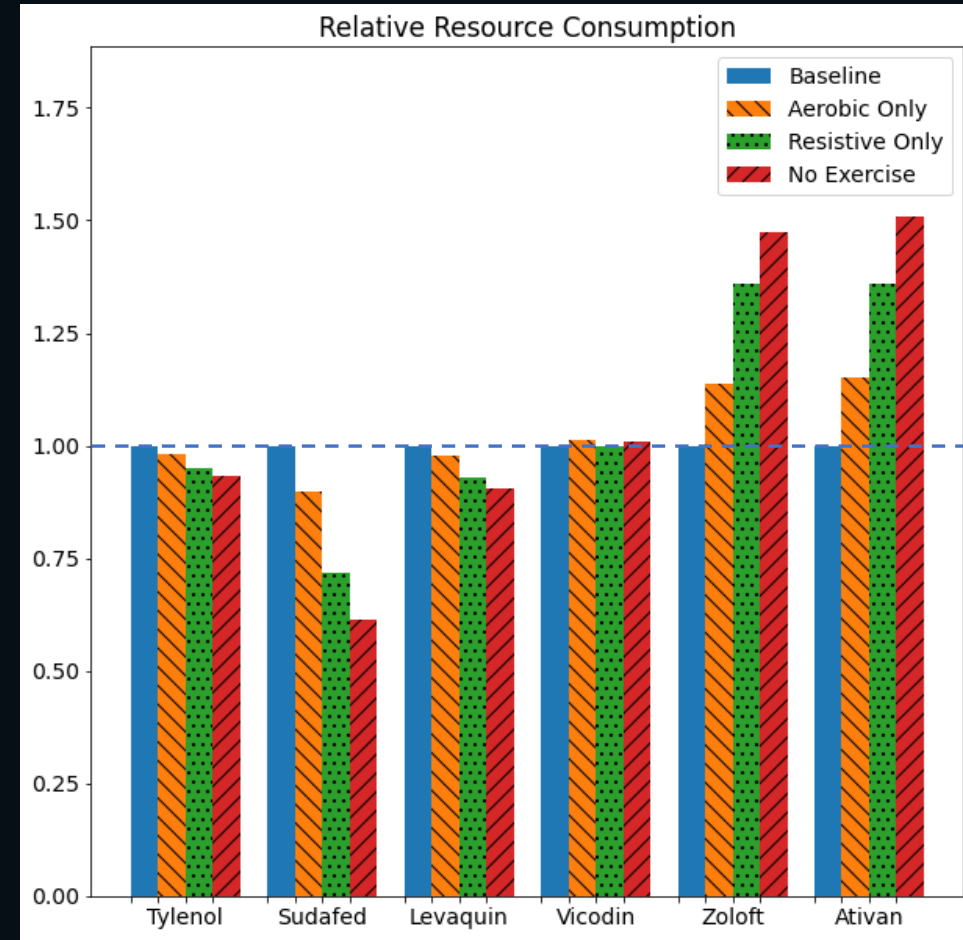
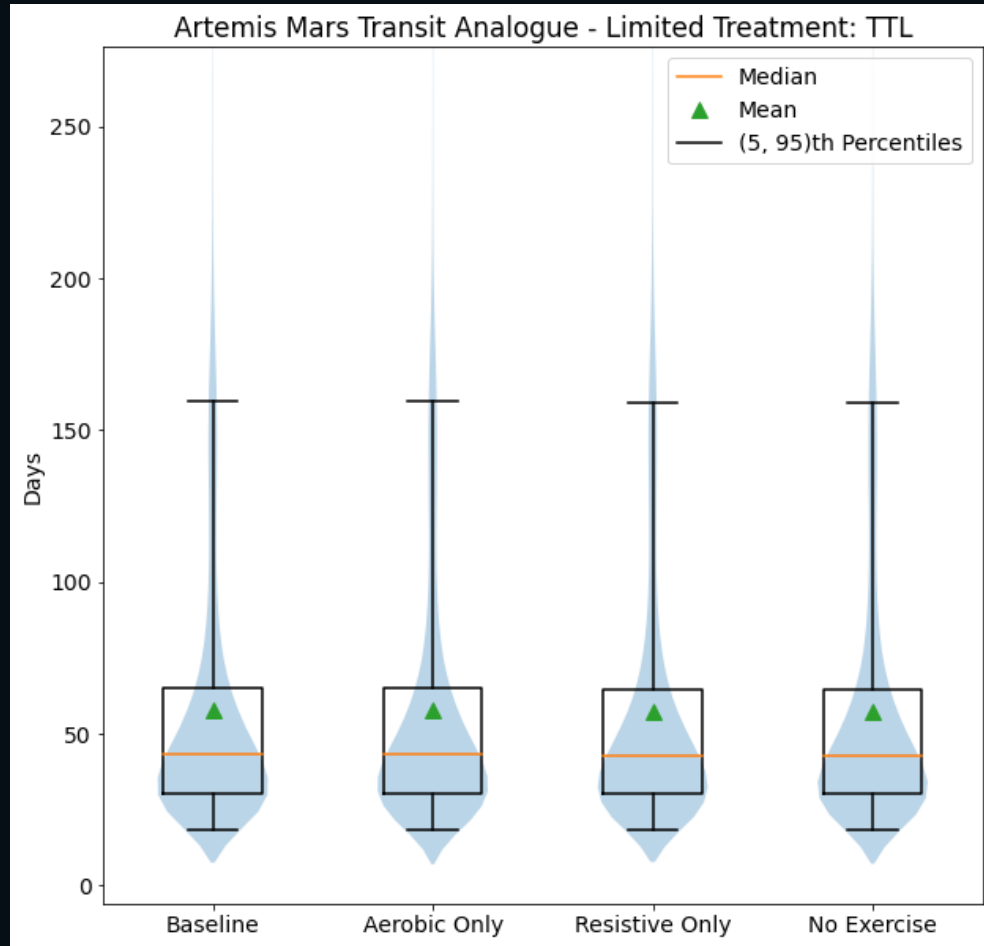


POC: Effect of Reducing a Capability to save M or V

Options for Evaluation



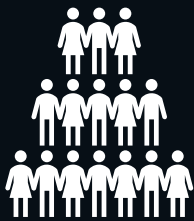
Mars Transit Analogue – Limited Treatment



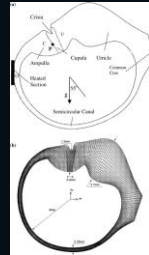
Collaborations, Integrations, and Next Steps



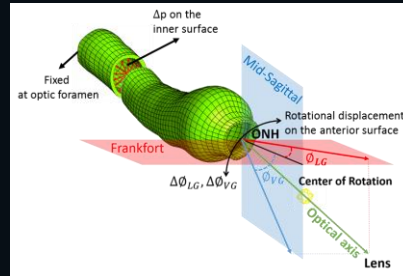
Radiation+ Long-Term Health Models



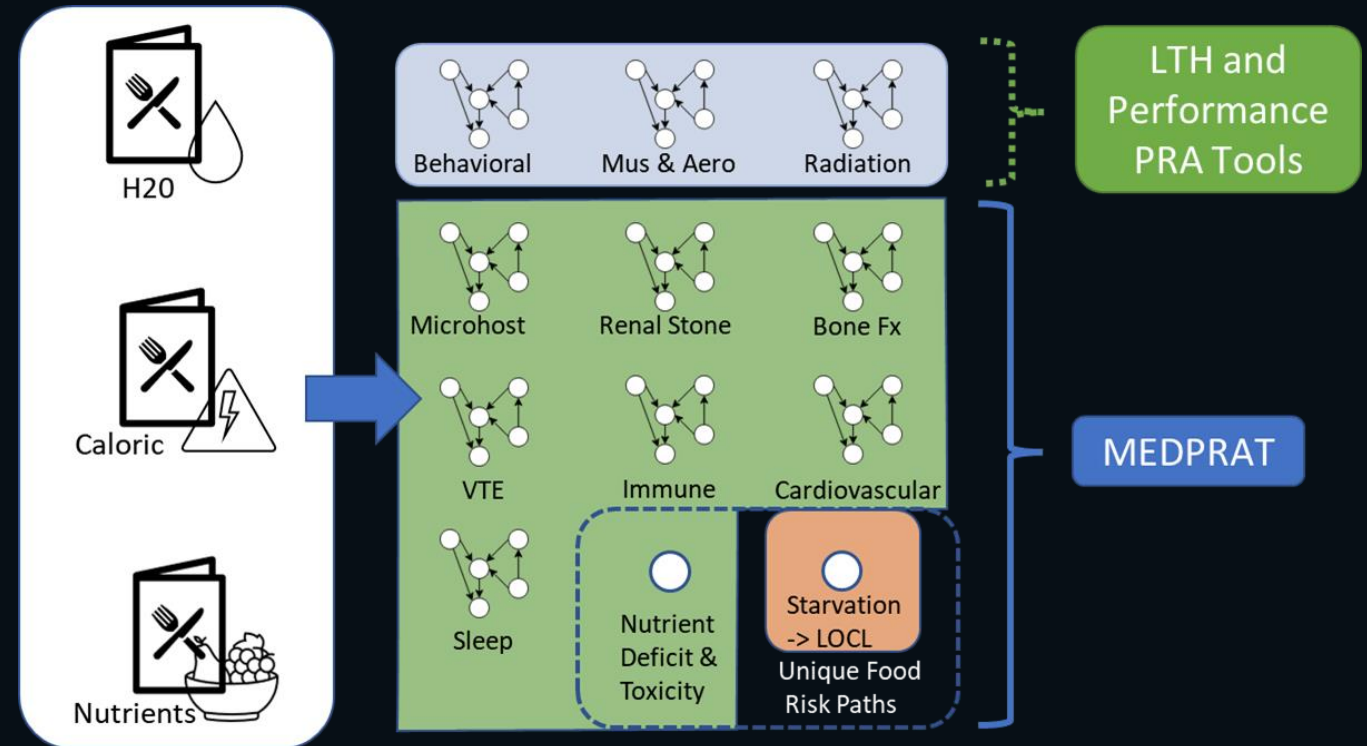
Agent-Based Models for Team and Behavior



Vestibular Performance Models



SANS and Cardiovascular Related Models



Long Term Health Efforts

LTH Metric Development TIMs with Stakeholders

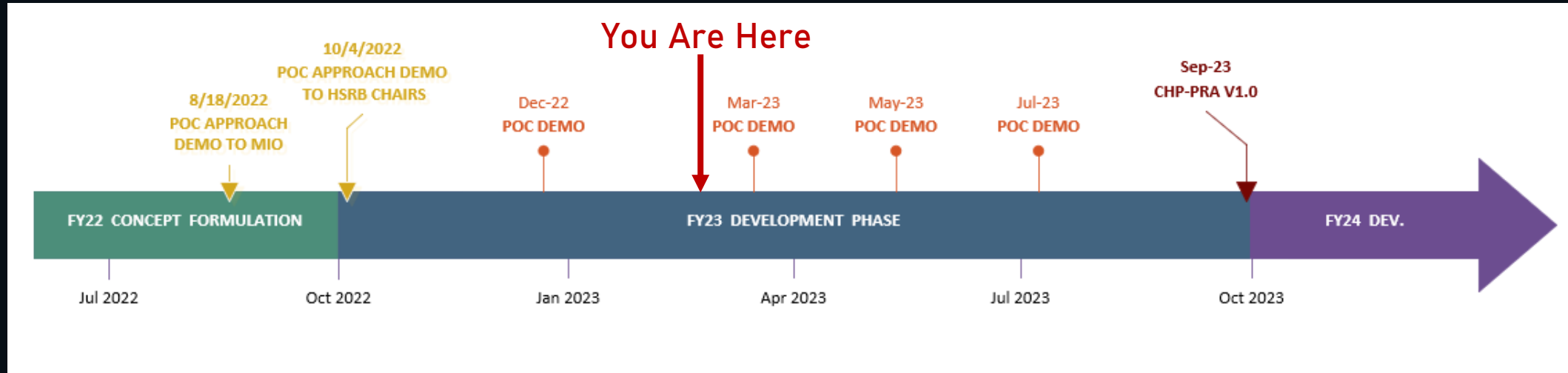


beth.e.lewandowski@nasa.gov

https://www.nasa.gov/content/national-space-council-users-advisory-group/membership_roster_b_aldrin/

LTH Outcomes	LTH Risks
Cognitive impairment	Behavioral Medicine
	SANS
	Radiation carcinogenesis
Long term psychological effects	Behavioral Medicine
	SANS
Vision impairment	Dynamic Loads
	Non-ionizing radiation
	Hearing loss
Hearing impairment	Hearing loss
Early onset osteoporosis and/or debilitating arthritis	Bone Fracture
Musculoskeletal disability	Crew Egress
	Dynamic Loads
Skin constrictions	Electric Shock
Long term complications from spaceflight medical conditions	Medical
Long term complications from malnutrition	Food
Kidney disease	Renal stone
	Urinary Retention
	Electric Shock
	Toxic Exposure
Long lasting effects from DCS or arterial gas embolism	Decompression Sickness
Long lasting/debilitating rashes, autoimmune disorders	Dust
	Immune
Cancer	Radiation carcinogenesis
	Immune
Effects from untreated infections or sepsis	Microhost
	Urinary Retention
Chronic cardiopulmonary disease, Pneumoconiosis	Toxic Exposure
	Dust

Frequent Feedback Welcome



Questions ?

Jerry Myers – NASA GRC
jerry.g.myers@nasa.gov